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West Europe Report

SCIENCE AND TECHNOLOGY

No. 55

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RECOMBINANT TECHNOLOGY PRODUCES CATTLE VACCINE

Frankfurt/Main FRANKFURTER ALLGEMEINE in German 4 Mar 81 p 31

[Text] A group of German scientists has succeeded in making a decisive advance in the prepartion of vaccines against foot-and-mouth disease. By means of gene-recombination techniques they have for the first time been able to make bacterial cells produce coat protein VP1, the viral component responsible for immunization. On the one hand, the replication of the dangerous virus can be circumvented in this manner; further, the technique facilitates adaptation of the vaccines to the various variants of the virus--more than 60 in all, in seven strains. Although the bacterial cells are as yet producing only traces of VP1, the experiments confirm that the procedure is suitable in principle for vaccine manufacture. For this reason the finding has been cited as a "milestone" in vaccine production by J.B. Brooksby, former director of the British Research Center for Animal Viruses, in a report in the journal NATURE (Vol 289, p 535), which also published the original article (p 555).

VP1 is by no means the first viral protein to be produced by bacteria as a result of genetic manipulation. Bacteria were successfully used earlier to synthesize Australia antigen, the coat of the hepatitis B virus, which is the causative agent of serum hepatitis. Australia antigen, which confers protection against infection with hepatitis B virus, corresponds to VP1. The fact that gene-recombinant techniques have specifically been developed to produce vaccines against serum hepatitis and foot-and-mouth disease is indicative not only of the great practical significance of these diseases but also of the advantages which this technology offers in this regard. For hepatitis B virus, it is still not possible to make the pathogen multiply in cell culture--an absolute requirement for vaccine manufacture. This step should be avoided as much as possible with foot-and-mouth disease virus, as there is always the possibility that the virus may be spread if it escapes from where it is being manufactured or if it is not completely killed in the vaccine.

Vaccines currently employed against foot-and-mouth disease contain complete viruses, grown in tissue or cell culture. They are inactivated by chemical treatment, so that they can no longer multiply in the animals to which they are administered, but they still initiate immunological defense reactions which protect the animals against infections from them or from similar pathogens. Since the body's defenses attack the viral coat, consisting mainly of various proteins, immunization with these coat components suffices to induce immunity. This is also true for VP1, as has been shown by experiments in pigs.

It is therefore opportune to use gene-recombinant methods to produce this substance from the protein coat of the foot-and-mouth disease virus in bacteria and to employ it for immunization. The most important step necessary for the procedure, the incorporation of the genetic information for VP1 synthesis into the bacterium Escherichia coli, has been successfully accomplished by the team of H. Schaller (Microbiology Division, Heidelberg University), K. Strohmaier (Federal Research Center for Viral Diseases of Animals) and P.H. Hofschneider (Max Planck Institute for Biochemistry, Martinsreid). The viral genetic material ribonucleic acid (RNA) was first converted to deoxyribonucleic acid (DNA) and then incorporated into a plasmid. Like viruses, such plasmids can easily be transferred to bacteria, which then form the proteins corresponding to the respective genetic information. To date there have been at least 1000 VP1 protein molecules per bacterium. Further tests must now be done to see if this bacterial strain is suitable for producing larger quantities of VP1.

All these experiments were done with virus strain O_1K, isolated in Kaufbeuren. If other virus strains are used, their VP1 can be synthesized in the same manner. Production of the three other components of the virus coat (VP2, VP3, VP4) is similarly possible. These can then be combined in a vaccine in practically any fashion desired. Since extraneous material, such as viral nucleic acid, can be eliminated in this way, more effective and also less dangerous vaccines against foot-and-mouth disease should sooner or later be practicable.

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BIOTECHNOLOGY

ACTIVITIES OF BIOTECHNOLOGY INDUSTRY REVIEWED

Duesseldorf WIRTSCHAFTSWOCHE in German 12 Sep 80 pp 36-44

[Unattributed article: "Life Drafted on the Drawing Board"]

> [Excerpts] Tailor-made combination domestic animals or even human beings are still fiction. But microbes, used increasingly as producers, are being programmed in the test tube for new tasks. The Germans must take care not to waste their bio-assets.

Startled by the slogans and successes of shirtsleeved American biological pioneering spirits, worried about Japan's hard-working bacteria strains, the British and the French are now also boosting their work in biotechnology.

Already, a planned joint European program on biotechnology and genetic engineering had its funds cut back as part of the jockeying for position among France, Great Britain, and the FRG--very much to the detriment of the smaller EC members. They have reason to fear that they will only be left with some crumbs in the form of their more modest national programs and that some of their ablest scientists will be drawn toward greener pastures--for example, in the FRG.

West Germany's biological research promotion efforts are certainly quite respectable in Europe: The Federal Ministry of Research and Technology alone between 1972 and 1978 released about DM150 million for biotechnological projects for potential markets. And DM177 million have already been earmarked for 1979-1982, plus more than DM66 millions for personnel and investments in the three major directions of research. The biggest chunk out of that will go to the GBF (Society for Biotechnological Research, Inc.) in Braunschweig-Stoeckheim. Acting as a switching station between college laboratories and industry, it is to develop methods on a pilot scale over the entire spectrum from natural substance chemistry all the way to gene transplants.

The Max Planck Society and the Fraunhofer Society annually spend about DM50 million --mostly from federal and state treasuries--on biotechnologically oriented basic research. The DFG (German Research Association) and the Volkswagenwerk Foundation likewise promote scientists who are developing basic biological knowledge for the practical applications of tomorrow.

Federal Research Minister Volker Hauff feels that the course is quite clear: "Biotechnology is a key technology whose expansion is necessary in order, over the next several decades, to be able to cope with the challenges in the areas of food supply, environmental protection, medicine, as well as energy and raw material supply."

Looking at it this way, to be sure, the funding from the BMFT [Federal Ministry of Research and Technology], compared to the Hoesch aid program or the contributions for space research (more than DM700 million in 1979), looks rather modest. And the share of biotechnology in Hauff's blessings in billions drops from 12.3 permill in 1977 to 8.6 permill this year.

"In view of the rather tight federal budget situation" the minister had to be satisfied with whatever had already been earmarked for the next several years in the form of subsidies for biotechnology. He hopes for "a more powerful commitment on the part of German industry--especially in view of rising activities in other industrial nations." Impetus from research promotion--he added quite in keeping with current market thinking--cannot "replace in-house initiatives."

Hereabouts it is especially the big chemical and pharmaceutical enterprises which picked up the ball. The leader among them is definitely Hoechst AG [Inc.]. It is involved in all important fields: bioreactors [biological reaction agents], in which bacteria make themselves useful, using the tricks of nature for themselves, gene engineering and immunobiochemical research. The Cryo-Bank-Krefeld of the Hoechst affiliate Messer Griesheim GmbH [Inc.] preserves living matter--from bacteria samples all the way to the calf embryo--in liquid oxygen in a deep-frozen manner.

"After all, not even the chemical industry can ignore the slogan 'back to nature,'" says Hoechst board chairman Professor Rolf Sammet. It seems that man "now more than ever before is acquiring the ability not only to imitate biological processes but to guide and transform them in such a way that they will be suitable for industrial utilization."

That this ability in his enterprise is as far developed as it is, the company owes to process management discoveries from traditional activity fields but also from occasional lucky accidents.

Here is an example: Single-cell protein (SCP) on a methanol base. Today, Hoechst and its plant construction affiliate Uhde GmbH offer complete production and refinement plants with a capacity of 100,000 tons per year and more. From the microorganism with the pretty name of Methylomonas Clara, which busily gobbles up methanol at 38-40 degrees Centigrade, to the big fermenter which can get along without a stirring mechanism, thus saving energy--everything is home-made or raised in-house.

When, in 1971, the parent company and the affiliate, together with Gelsenberg AG, which dropped out later, began the project that was promoted by BMFT, the people at Hoechst "really were least interested of all," Dr Uwe Faust reminisces, while Uhde was with it from the very beginning. Originally, the goal was to convert waste paraffin from the Gelsenberg refineries into protein. But Hoechst knew its way around in handling microorganisms from its earlier production of antibiotics (fungus cultures).

The Hoechst-Uhde development projects were aimed at the growing protein gap, which nutrition experts expect above all in the countries of the Third World. Even today, raw SCP, a dry powder which can be stored for a long time, is cheaper as animal fodder there than soybean scraps, where methanol, due to the rich oil wells in the country, is produced more cheaply than in European refineries. (But methanol can also be obtained from coal or wood waste.) In less favored regions, including hereabouts, the competitive capability of bioprotein depends on the whims of soybean prices. But those prices shoot up and down depending upon the production of American farmers in the hog cycle. However, feeding SCP for milk and meat production is not the last word here. "In this process, 90 percent of the energy contained are lost," says Dr Merten Schlingmann, who is responsible for SCP product development at Hoechst. The next step involves processing into pure protein which man can also tolerate. "Not synthetic steak," but low-cal diet is the objective here--according to the formula: increase the protein and cut down on carbohydrates and fats in TV snacks and noodles, beverages, or sausage.

The bioreactor builders look at the protein project in a more global fashion than merely as the learning model which--according to Dr Faust--opened up further biotechnological applications for them on a large scale. "We can today offer a series of apparatuses and methods unlike anybody else--not even the Japanese," Dr Faust believes. Future producers of biofuel from the United States have already been knocking on the door.

Stirred up by the BMFT, a real development boom has broken out hereabouts in fermentation plants. Elsewhere, people are still looking for more efficient bacteria and yeast strains while improved culture conditions are being devised for performance [output] doping. This is because the future belongs to highly specialized microbes: Where traditional chemical processes require high temperatures and heavy pressures, bacteria work in an energy-saving manner at normal pressure and roughly at body temperature.

Even today it pays off in dollars and cents not synthetically to imitate certain natural substances but rather to produce them with the help of living minichemical plants. Thus, citric acid is already being produced in large quantities from molasses (beet residues from sugar refineries)--and this is a traditional major production program of the pharmaceuticals manufacturer C. H. Boehringer Sohn, Ingelheim. Chemical products from natural substances and experiences gained are also being contributed by the American Bayer affiliate Miles Laboratories, Inc., and Diamalt AG, a recent acquisition by Schering of Munich. Schering has been trying "for quite some time to get into areas based on regenerating raw materials and Diamalt fits in very nicely in terms of the production program," we learned from headquarters in Berlin.

BASF [Baden Aniline and Soda Factory] AG is also drawing nourishment from nature. Research director Dr Horst Pommer believes that promising fields are to be found in the microbiological procurement of vitamins (as substitute for full-scale chemical synthesis), biochemical raw materials for pharmaceutical products, and the production of refined [precision] chemicals using enzyme catalysts. Pommer expects the first market-ready results of the interdisciplinary biochemical study group to come out already during the first half of the eighties.

With support from Bonn, Degussa and Dynamit Nobel AG are developing new methods of making L-aminoacids with the help of enzyme catalysts. The latter are needed for artificial nutrition, as animal fodder additives, and as raw materials for pharmaceutical products. Degussa thinks highly of the enzyme method because it "promises to become considerably more economical than the hitherto used synthetic methods."

The federal government also hopes to get help from microbes: to assure a raw material supply, these tiny miners, following American examples, are to haul iron metal rations from domestic poor ores (uranium, perhaps also copper), from dumps in the Harz Mountains (lead and zinc) and from smelter residues, in an environmentally safe fashion. In addition to the Federal Institute of Geosciences and Raw Materials in Hanover, the University of Dortmund and the Uranerzbergbau GmbH in Bonn and Saarberg Interplan GmbH are also involved in these experiments.

Even in domestic garbage, bacteria could someday poke around for metals. "The residues from refuse incineration plants," according to Dr Klaus Bosecker, of the Federal Institute, "contain partly still considerable quantities of valuable metals," which can contaminate the ground and the water in refuse dumps. Bacterial metal recovery therefore "can make important contributions to environmental protection" (Bosecker).

Today already, modern filter plants can no longer get along without activated sludge basins for biological purification. We are now moving into the third dimension: with compact filter towers based on the bioreactor principle, which promise to create less odor and noise, Bayer and Hoechst-Uhde compete for orders.

Krahn Chemie GmbH, of Hamburg, is doing good business right now with specialized wastewater bacteria which decompose fats, hydrocarbons, or cellulose-containing residues. It is importing high-performance microbes in the form of dry-frozen powder from Ireland, where Worne Biochemicals (Europe) Ltd. produces mutations in and multiplies selected strains through irradiation. Some outfits do not even shy away from hydrocyanic acid. Even mixtures--which can be used in restaurants and meat packing plants as living effluent purifiers--are being offered.

Several projects, promoted by the BMFT, are aimed at producing additional value and nutrition value from wastewaters deriving from the food industry; microbes obtain albumin from whey-containing and starch-containing wastewaters which otherwise would be an extreme burden on filtering plants and which would push sewer connection fees up. A sore point here is also the fluctuating soybean price which sometimes pulls this kind of residue utilization above and sometimes below the profitability threshold.

With all of this biotechnical progress drive, it is almost astonishing that, of all things, those branches which have always been familiar with handling microbes and enzymes, are not in the lead but rather at the tail end, for example, breweries, liquor distilleries, or dairies.

Most of them are too small to engage in research and development all by themselves --a handicap which they try to eliminate through research associations and institutes on the branch level. But there is one characteristic feature of these branches which constitutes a more serious obstacle: concentrating fully on their usual products and partly also on traditional methods, they do not have the right vision and the proper interest in new possibilities for using their treasure of microbiological experience.

"Very conservative thinking" in this respect is what BMFT section chief Dr Hartmut Keune called it in talking about German farmers. Indeed, even the gigantic beer corporation of DUB-Schultheiss AG, in spite of market saturation with biodiversifications, such as in the food or natural substance sector, has nothing on the drawing board. "That sort of thing does not fit in with our sales channels and rationalization in beer brewing already keeps us very busy," says chief engineer Dr Karl Diether Esser in explaining the priorities.

In France, on the other hand, the Moet-Hennessy champagne and cognac group and the BSN-Gervais Danone food concern are among the founders of the Transgene development firm which, following the United States model, is supposed to explore industrial applications of genetic engineering.

As far as biotechnology is concerned, gene transplants point to a similar revolutionary output surge as microelectronics accomplished for the machine-building industry; in both areas, stored information is being built in on the very smallest format so as efficiently to control complicated processes. The genes, so to speak, are the biochemical microchips of nature. By inserting specialized genes from foreign organisms, it is possible to utilize bacteria strains, which are busily producing and reproducing, for the manufacture of substances which originally are not provided in their genetic programs.

The pharmaceuticals industry thus has an opportunity of obtaining rare incorporated active substances found in the body in a purer form, in larger quantities, and more cheaply than so far. For example, human insulin and interferons around which a gene-engineering research race has begun among international pharmaceutical concerns--including also Hoechst AG.

In the case of insulin, the driving force comes from the threatening shortage because the number of diabetics, who must be supplied with the hormone artificially, is in the millions, worldwide, and keeps growing daily. Someday, the experts fear, substitute insulin from the pancreas of cattle or hogs will no longer be enough. Experts estimate the market for insulin from reversed-polarity bacteria at DM50 billion annually.

Even today, human interferons are among the most expensive rarities. Just one gram costs DM100 million. They have been known for quite some time in specialist circles as defensive substances against viruses. But financial support and loud publicity were devoted to interferon research only since interferons themselves have come to be considered as a rather debated hope against cancer.

Interferons however must still be extracted from human cells through expensive methods: leucocyte interferon from white blood corpuscles (chief supplier: the blood bank of the Finnish Red Cross) and fibroblast interferon from cell cultures which hereabouts is supplied by the medium-sized firm of Dr Rentschler Arzneimittel GmbH

& Co. in Laupheim, Swabia. The pure-substance content is rather scant even in the case of top-level preparations--at most one percent. The quantities thus produced are far from enough for biochemical and clinical tests.

In the meantime, the gene engineers at Hoechst AG have managed to reprogram coli bacteria in such a manner that they can produce preproinsulin or a "substance with interferon-like action" (according to Hoechst spokesman Professor Dietmar Gericke). (Preproinsulin can be converted into insulin chemically in a relatively uncomplicated fashion.)

In both cases, the people at Hoechst had to allow others to pull ahead of them, even though only just barely. In the case of interferon, the gene trick was first successfully accomplished by Zuerich Professor Charles Weissmann for the trans-Atlantic research firm of Biogen S.A. [Inc.] which he helped found and in which the American pharmaceutical corporation of Schering-Plough participates. In the case of insulin from bacteria, the specialists at Genentech Inc., which will shortly sell stock on the stock exchange, for the time being pushed the world's biggest insulin producer, Eli Lilly, to the top. Nevertheless, Hoechst board chairman Dr Wolfgang von Poelnitz remains rather nonchalant: "You can do this thing only one by one" (see interview page 46 [of original]). Success in the laboratory does not signify an economic breakthrough by a long shot. In the case of insulin, Hoechst even believes that it has found the better method.

Hoechst took a chance in getting into gene engineering when many competitors were still hesitating. "About 3 or 4 years ago, even famous scientists doubted that commercially useful successes could be achieved with this thing," reminisces Hoechst geneticist Dr Juergen Gruneberg. Kinship bonds helped give the people at Hoechst courage. Among the group of scientific advisors, Munich Professor Ernst Ludwig Winnacker--a son of the long-term board chairman and board of governors chairman Professor Karl Winnacker--came out in favor of gene engineering.

Schering and Boehringer Mannheim GmbH are also detecting positive prospects for gene transplants. Working with the insulin model, Schering researchers learned the techniques with which they now want, with the help of bacteria, to produce "other proteohormones which can be used as medications." The biochemical research center of Boehringer Mannheim is equipping coli bacteria with foreign enzyme programs. According to center director Dr Wolfgang Gruber, the goal is "to reduce the cost of enzymes for diagnosis purposes."

Bayer researchers hope to solve wastewater problems through gene manipulation. They want to create bacteria which can better decompose chlorinated hydrocarbons. Genetic surgery experiments, using bacteria that will crack noxious substances, at the Max Planck Institute for Molecular Genetics in Berlin, are also designed to yield a higher output.

If we are to believe English scientist Howard Dalton, genetically pepped-up bacteria will, already "within 10-15 years," on a large scale make many semifinished products for dyes, synthetics, pesticides and insecticides, as well as medications, from petroleum and coal derivatives. Methylococcus capsulatus, the future goblin of large-scale chemical industry, can oxidize the most varied hydrocarbons. Dalton's research team turned it into an assembly line worker--by means of gene multiplication--with a hundred times the creative force of natural colleagues.

Someday, on the other hand, the market for nitrogen fertilizer might shrink--if one of the dream goals of genetic engineers is achieved: the ability of some bacteria to get nitrogen from the air, to transfer it to plants. In the model case, a team under the direction of the Belgian Professor Jozef Schell, at the Max Planck Institute for Breeding Research, in Cologne, was successful in sneaking bacterial genes into plants.

The FRG is not at all in a bad position when it comes to moving into the gene era: years before the much-quoted verdict of the United States Supreme Court, the German Federal Court declared that systematically produced new forms of life are fundamentally patentable. And on questions of safety, there seems to be a pragmatic consensus at this time between the BMFT and enterprises engaged in research.

Nevertheless, Professor Peter Hans Hofschneider, the business manager of the Max Planck Institute for Biochemistry, is bothered by doubts as to "whether we have hereabouts fully recognized the potential of gene engineering." He is familiar with the international competition situation not only in his capacity as basic researcher. "Out of joy derived from cooperation, not so much for the sake of money," he is a member of the ten-man, internationally mixed body of advisors in biogenetic matters.

Hofschneider is afraid of a "worrisome" personnel drain in terms of able successors. The job situation at West German colleges and institutions is somber. "Many people figure that it makes no sense any longer and therefore accept positions not involving any research, for example, as clinic consultants."

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BIOTECHNOLOGY

COMPANY DEVELOPS COMPUTER-CONTROLLED SYNTHETIC DNA MACHINE

Stockholm NY TEKNIK in Swedish 12 Feb 81 p 4

[Article by Lars Eriksson: "Here is the Machine Which Produces Synthetic DNA"]

> [Text] Synthetic DNA--artificial molecules which carry genes--will be produced by a machine developed by KabiGen. Today they have a prototype machine where production is controlled by a microcomputer.

The machine produces nucleotides, the building blocks of the DNA molecule. The work goes 30 times faster than today's manual methods.

Nucleotides which the machine produces can later be "spliced" with the help of an enzyme (ligase) to genes. The genes then acquire the property decided upon and can be used for the production of, for example, the cancer medicine interferon or insulin for diabetics.

Washing is the First Step

The action which takes place in the so-called stable phase causes one of the DNA molecule's four nucleotides, T, G, A, or C to be spliced to a carrier in the form of about 200 milligrams of silica gel. This is a stable, porous material made of silicic acid. The linkage between the nucleotide and the silica gel happens in a column.

The first step in the process is washing. Then comes neutralizing of the protective group. This means that if the nucleotide silica-T is present, a hydrogen group is freed. The result is silica-T-OH.

The column is washed again and a reagent in the form of phosphor chlorite of tritylerade nucleotides is added. The result is silica-T-T.

The Cycle is Repeated

After one more washing oxidation is begun. The cycle is ended with "capping." That means inactivation of unreacted hydroxy groups. Then the cycle is repeated and the length of the chain is extended.

The result is an oligonucleotide which contains several of the nucleotides T, G, A, and C in sequence. At KabiGen they have generally produced 12-oligonucleotides, for example in the form T-C-T-A-G-A-A-G-A-T-C-T.

This process has previously been carried out manually, but KabiGen now has a machine controlled by a microprocessor (ABC 80) which does the job. The machine can be programed to follow a certain sequence.

The Machine Saves Time

"We are saving time with the machine," said Tomas Kempe, PhD, who is in charge of the synthesis group at KabiGen.

He said, "8 or 10 years ago it took up to 6 months to produce a 12-oligonucleotide. With the classical phosphor triester method, which is still common, it takes about 2-3 weeks. This machine does it in about 12 hours, which has also reduced costs to one-hundredth of that of the manual method."

About Nine Hours

The synthesis group, which besides Tomas Kempe consists of Flora Chow and Gunnar Palme, has worked with Professor Marvin Caruthers at the University of Colorado in the United States. He is considered to be the creator of the synthesis method.

In the United States and Canada several firms have working synthesis machines.

Bio Logicals in Toronto, Ontario, which introduced its machine several weeks ago, said that it produces a 12-oligonucleotide in about 9 hours.

The KabiGen machine in its present form will produce a 12-oligonucleotide in 9-12 hours. The Canada firm is said to have made 20-oligonucleotides. Their machine will be on the market at the end of April 1981 and will cost about 100,000 kronor.

Control of the Patent

Vega Biochemicals in Tucson, Arizona, has a machine which is said to cost 250,000 kronor. It reportedly takes 36 hours to produce a 12-oligonucleotide.

Genetic Instruments Co. is expected to have a machine on the market toward the end of 1981. The machine was developed by Marvin Caruthers, among others, with whom KabiGen has worked.

"Our machine can easily cost about 60,000 kronor, but we can not put it on the market now. First the patent situation must be established," said Tomas Kempe.

Facts About KabiGen

KabiGen is 50 percent owned by the government's Kabi Vitrum. Svenska Sockerbolaget has 25 percent, and Hilleshog AB has 25 percent.

The firm has been much discussed during the past year since it applied for permission for a so-called high risk laboratory in Stockholm where human growth hormones were to be produced.

Since security requirements have been reduced, KabiGen now has permission to produce growth hormones in 10-liter amounts in a laboratory with a lower degree of security.

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BIOTECHNICAL

GENETIC ENGINEERING PRODUCES 'SUPER-GRAIN'

Best Features of Rye, Wheat

Milan L'UNITA in Italian 23 Feb 81 p 7

[Article by Pier Giorgio Betti]

[Text] Scientific research teams at the Nuclear Energy Commission (CNEN) laboratories made one cross-pollination after another, and came up with super-grain. It is a more prolific bearer than ordinary wheat, but scientists are naturally cautious, and nobody is crying "Eureka!" yet.

The newest arrival at the National Nuclear Energy Commission research station at Casaccia a few kilometers north of Rome has been baptized "Mizar." Remember that name: we are likely to be hearing a lot of it in the next few years. Scientifically speaking, Mizar is a triticale, a cross (there are already thousands of "types) between wheat and rye which is usually sterile when it occurs in nature, but which has been rendered fertile by means of radiation-induced genetic mutation or special chemical treatment in the laboratory. While Mizar is genetically similar to soft wheats, it is an altogether extraordinary triticale, compared with what the laboratories have come up with so far.

Imagine a car that performs like a Ferrari but gets as much mileage as a sub-compact, and you will have an idea of what Mizar can mean to grain farmers, as well as of the importance of this discovery, credit for which goes to the Nuclear Studies Center and particularly to Dr. Luigi Rossi, who heads the Center's agricultural experimental and development activities. Mizar, as its "sire" explains it, offers the ideal combination of the most desirable features of both wheat and rye for our agronomic environment. It can thrive where ordinary grains barely sprout. It ripens faster, is hardy in cold temperatures and resistant to disease, and sturdily holds its own against weeds. It requires less fertilizer (hence causes less pollution) and gives higher yields.

It took years of patient work at restructuring experiments performed in the international institutes, but the results of this successful genetic engineering operation look truly remarkable. When farmers in a number of areas in the Emilian Appennines planted the new grain last year, they harvested as much as 45 quintals per hectare from fields that never yielded much more than 20 in the past. Now there are thousands of hectares planted to this crop, and stacks of requests for it coming in from growers all over Italy.

Do we at last have the "super-grain," as somebody has called Mizar? Let's keep our feet on the ground: they have certainly not found the key to a solution for the problem of hunger in the world, partly because no scientific achievement, brilliant though it may be, can cure by itself the terrible scourge that afflicts the peoples of so many Asian and African lands. Mizar, though, does look to us like one of the more convincing pieces of evidence of what can be done with scientific research and with new cropping techniques to improve agricultural productivity.

Beginning, be it emphasized, with agriculture here at home. One need only remember that we must import all our forage grains (and Mizar is rated A-one as a feed grain for cattle) to untoward effect on our balance of payments, and without any real possibility of using grains bred for their suitability to our farming areas.

That means an all-out push for research and experimentation in agriculture. This is a must if we want to keep up with the times, improve the competitive stance of our products on the market, and fight inflation. But how are we going to do it, as long as research is our Cinderella, to whom we begrudge structures, staff, and money?

Characteristics of Grain

[Article by Dr Luigi Rossi, research worker at CNEN's Casaccia Center]

[Text] Mizar, like all the triticales, is the offspring of genetic material from two genera: Triticum (wheat) and Secale (rye). That analogy led to its being named for a double star, the second in the tail of the Great Bear.

Mizar is one of thousands of strains of triticale which CNEN research people have developed in the nuclear study centers at Casaccia and in other places in the Appennines, in the Alps, and in Sicily. Although it grows 25 to 30 centimeters taller than wheat, it is equally resistant to straw-wilt (the flattening of the stalk under the effect of wind and rain); it ears 15 to 20 days earlier than ordinary wheat varieties; it is most efficient at utilizing nitrogen fertilizer, although it thrives better than wheat in fairly barren soil and even in problem soils such as acid clays; it is highly resistant to culm and leaf rusts and immune to Oidia (a serious disease in grains). Mizar is self-fertilizing. Owing to a slight stunting of the grains, its weight by bulk is slightly less than that of soft wheat. Its planting season is the same as that of wheat: autumn; it can also be sown as a spring crop, but the yield will of course be less abundant.

Sowing density is the same as that prescribed for wheat. If Mizar is to be used for silage (the product resulting from anaerobic fermentation of the finely chopped plant) sowing density should be slightly increased.

Fertilizer application is the same as for wheat, provided surface dusting with nitrates is done early (when the young plants already cover the ground). Weeding is not always necessary, since Mizar competes vigorously with weeds. Should it be necessary, the same herbicides used on wheat crops will do. In the fertile environment of central and northern Italy Mizar can really show what it can do, with yields running 15 to 25 percent higher than wheat. Even in the poor flatlands and in mountain soils, Mizar produces more abundant crops than wheat.

As for utilization of the new product, livestock feeding is the simplest considering Italy's grave shortage of forage grains. By comparison with wheat-and-barley silage, triticale silage offers higher productivity in terms of biomass and unit of forage, which is to say in quality as well as quantity.

The grain is extremely nutritious, particularly in that it contains a high percentage of lysine, an important amino acid. It is now being tested as feed for hogs, poultry, and beef in order to determine the real biological value of Mizar's triticale grain, and thus make an objective assessment of its commercial value. From the purely nutritional point of view, there is no objection to the use of Mizar in human nutrition. Its performance in breadmaking, however, does not come up to the technological standards required of soft wheats. Even so, some excellent white and graham breads are made from it, and the people who have tasted it like it.

6182
CSO: 3102

ELECTRONICS

ELECTRONICS INDUSTRY THRIVES IN WESTERN EUROPE

Paris AFP SCIENCES in French 8 Jan 81 p 21

[Text] London--Electronics under full development in Western Europe: Despite the slow-down in economic expansion, the electronics "boom" will continue in Western Europe at an annual rate of 11-12 percent during the next few years. This is the forecast of the "Mackintosh Electronics Yearbook," the electronics annual published by the Scots professional consulting firm of Mackintosh.

For 1981 an increase of 12 percent is expected, compared to an average expansion of only 1 percent in the gross domestic products of the countries of Western Europe. During the year just ended, it should also have reached 12 percent. Thus this year the West European electronics market should attain a value of 103 billion dollars (in constant dollars) compared to 92 billion in 1980 and 82 billion in 1979.

The professional consultants base this optimism on the rapid rate of innovation exhibited by this industry.

According to them, West Germany, already the principal individual market, will again experience the most rapid growth in 1981 with a rate of more than 13 percent, which will bring the value of its market to nearly 27 billion dollars.

For its part, the French market should grow by nearly 12 percent to exceed 20 billion dollars in 1981, but the British will develop a little more rapidly--nearly 13 percent--to reach nearly 20 billion.

In the consultants' opinion, the sectors destined to experience the most rapid expansion next year will be data processing and, to a lesser extent, office equipment (primarily photocopying), control and instrumentation systems, medical equipment, military materiel (particularly NATO warning and communications devices), integrated circuits and other components.

However, they issue a warning: the consumer-goods sector will stagnate on the whole between 1981 and 1984 in the vicinity of 15 billion dollars per year.

There is, nevertheless, one exception: electronic watches, the sales of which will increase from some 48 million in 1980 to nearly 68 million in 1984, or at an annual rate of 9 percent.

As for video games, according to the yearbook their popularity probably reached its peak in 1980 with 4.2 million units, more than 30 percent of which were sold in Great Britain.

CSO: 3102

ENERGY

NEW ORDER PERMITS ERECTION OF THOUSANDS OF WINDMILLS

Copenhagen INFORMATION in Danish 4 Feb 81 p 9

[Article: "Windmills May Now Be Erected Almost Everywhere; Municipalities' and Counties' Refusal Overruled by the Planning Administration in Accordance with Environment Minister's Recommendation"]

[Text] The Environment Ministry has now opened the door for the erection of smaller windmills by the thousands all across the country. This is taking place after the heating planning committee under the Energy Ministry has submitted its third partial report, in which windmills in the hundreds of thousands are indicated for the purpose of supplying heat. The Environment Ministry has sided with this proposal in a memorandum to the Energy Ministry, in which Environment Minister Erik Holst states that "out of consideration for the environment it is desirable that a changeover be made from polluting oil burners to continuous energy sources kinder to the environment."

Therefore the minister has now informed the Planning Administration that everyone who applies for permission to erect windmills will receive this permission "without the stipulation of special terms" and "regardless of which conservation-zone area of interest the matter affects," as Erik Holst puts it.

The minister emphasizes that "a desired installation ought to be refused only in those exceptional cases when extremely weighty landscape considerations speak decisively against it."

Architect Carl Evald Hansen of the Planning Administration tells INFORMATION that this means that smaller windmills, i.e., windmills under 100 kW, may now, for all practical purposes, be erected everywhere on open land and that all the complaints the Environment Ministry and the Planning Administration have from applicants over refusals from local municipal governments or county councils are now being accepted by the Planning Administration.

"It is now only a question whether windmills may be erected in protected areas, where it is necessary to make a decision in each individual case," says Carl Evald Hansen.

Is it not also a question of how one interprets the expression "extremely weighty landscape considerations?"

"Yes, but in our understanding it is a question of Ejer Bavnehøj and equivalent localities."

Carl Evald Hansen reports that the new guidelines are now being worked into impending circulars.

Environment Minister Erik Holst's guidelines indirectly address, for example, the North Jutland and Funen county councils, which have created private rules for the construction of continuous power plants. In North Jutland County, for instance, some windmills have been prevented by requiring that they be placed close to buildings for landscape reasons. In Funen County it was required that applicants obtain signatures from their neighbors that they did not have plans to build windmills. There was no authority for any of these requirements, they say at the Planning Administration, but now it is being said directly.

The new rebate system went into effect as of Monday, whereby people who wish to use continuous energy can receive a 20-percent rebate for the construction of a plant which utilizes, for example, the sun, wind and biogas.

However, this did not mean that those interested could everywhere get information from municipalities regarding how they should apply. The municipalities informed them that they did not know.

Lis Jantzen, LL.B., of the Energy Administration tells INFORMATION that the notice regarding the system together with application forms were sent by the administration to the municipalities on Friday and therefore some letters had not shown up when the system went into effect on Monday morning.

Lis Jantzen reports that about 1000 of the 4000 applicants who up to now have been on the waiting list for receiving rebates have accepted offers of rebates according to the new system.

8985
CSO: 3102

ENERGY

SWEDISH FIRM DEVELOPS MORE EFFICIENT DRY CELL BATTERY

Stockholm NY TEKNIK in Swedish 19 Feb 81 p 14

[Article by Ulf Bergmark: "Higher Energy Density in Alkaline Dry Cell Battery"]

> [Text] The vacuum-packed "beefsteak" in the photograph [photo not reproduced] is an alkaline battery. It is protected by about 20 patents and has a capacity exceeding other alkaline batteries on the market.

This year perhaps there will also be introduced an accumulator built on the same principle.

"The battery can be built with four times as much energy density as an ammonium chloride battery," said Kjell Edwall, managing director of Dry Battery Energy Development AB in Stockholm. Ammonium chloride batteries are the traditional dry cells, such as those used in flashlights. Dry Battery Energy Development AB has recently taken over a battery factory in Kajana in Finland.

Tests conducted by the company in Finland show that voltage losses are small even at temperatures down to -40°C. Traditional batteries do not function at all at such low temperatures.

This is how the battery is made:

An electrolite based on manganese dioxide is sealed between a zinc and a carbon plate in tough plastic foil. Then the package is pressed with a pressure of 20 kilonewtons. That reduces the volume by half. The result is handy cells which can be assembled into batteries of various sizes.

Higher Energy Density

Starting in May 50,000 batteries per month will be exported to the United States. They are purchased by instrument manufacturers. Beginning in the fall the export will increase to 100,000 batteries per month. The price for these batteries is approximately double that of corresponding ammonium chloride batteries. That is believed to be offset by the much higher energy density.

Vacuum-packed batteries have primarily been made by hand since 1974. They are used in Sweden by the National Road Administration, Swedish Railways, and the National Administration of Shipping and Navigation, among others.

Now a development firm in Helsinki has also brought out a production method for mass producing the battery with a higher energy density.

The development firm under engineer Pentti Tamminen is now also controlled by the Stockholm company Dry Battery Energy Development AB, shortened to Endev.

The development of an accumulator built according to the same principle has been going on for several years. At Endev AB in Stockholm they hope to present an accumulator this year. It is much more difficult to build a chargable battery than to build a one-time battery.

Half as Heavy

These are the test results that Endev obtained with the latest prototype:

- It endured an unknown number of charges and discharges After 300 discharges of 75-80 percent no chemical changes could be detected.

- Energy density of the prototype is 70 watt-hours per kilogram. An ordinary lead accumulator has an energy density of 35-40 watt-hours per kilogram.

A battery built on this principle will be only half the weight of today's battery.

The price will not be markedly higher than today's lead battery.

9287
CSO: 197

ENERGY

UK TO BUILD LARGE WIND POWER PLANT ON ORKNEY

Stockholm NY TEKNIK in Swedish 19 Feb 81 p 17

[Article by Mikael Holmstrom: "England Follows United States and Sweden: Investing Now in Wind Experiments"]

> [Text] The British Department of Energy will build a large wind power plant on Orkney, north of Scotland. The power plant will have a turbine diameter of 60 meters and an output of 3 megawatts. It will be ready in 1983-84, and is in the same size class as the Swedish and American power plants to be put in service this year.

Burgar Hill on Orkney, north of Scotland has been chosen as the location for the large prototype power plant.

Britain's Secretary of State for Energy David Howell, in announcing the decision, said, "The wind speeds, together with the relatively low capacity of the electricity net and the cost of producing electricity with diesel generators makes this a good testing place for a wind power plant."

Same Line as Sweden

Already this year a smaller power plant was put into operation, with a 20 meter turbine diameter to get better measurements and wind data until the larger one was ready. The British are expected to select the same line of development as Sweden--a smaller installation (Kalkungen at Alvkarleby) followed by a larger.

The larger power plant with its turbine diameter of 60 meters and its output of 3 megawatts will have a format and performance near that of the power plants now building in the United States and Sweden (Maglarp and Nasudden, ready this year and in 1982).

The Swedish power plants have two-bladed turbines with a diameter of 80 meters and generator outputs of 2 and 3 megawatts.

The large British power plant was designed by a consortium which also expects to get the order to build it.

The firms in the consortium are British Aerospace Dynamics Group, Taylor Woodrow Construction Ltd, and GEC Power Engineering Ltd.

Built of Steel

The power plant will have the turbine placed on the windward side of the tower. The machinery building will be mounted on a 46-meter-high concrete tower.

Differing from the American and Swedish power plants, the generator and the gears will not be mounted on top of the concrete tower, but rather beside it, between the tower and the turbine. The turbine, which is two-bladed, will be made of steel. The angle of the blades will be fixed, except for the tips which will be rotatable.

The turbine will rotate 34 revolutions per minute in a wind velocity of 7-27 meters per second. The plant will give full output of 3 megawatts with a wind velocity of 17 meters per second.

The power plant will cost about 60 million Swedish kronor, which is somewhat more than the cost of corresponding Swedish prototypes. But considering inflation the costs are about the same.

9287
CSO: 3102

ENERGY

OBSTACLES IN PATH OF SUCCESSFUL ALCOHOL FUELS PROGRAM

Carburol Program

Paris INDUSTRIES & TECHNIQUES in French 10 Feb 81 p 7

[Text] 1 and 1/2 million tons of hydrocarbons to be saved beginning in 1983... 5 percent of French consumption... The Carburol Plan announced with much fanfare by the government has promised us miracles. The festive lanterns have been extinguished. And now there remain the problems. They are as numerous from the standpoint of designing motors to use a "carburol" fuel as they are from that of producing the "carburol" itself. "Easier said than done!" were the words used, with obvious distress, by the sales manager of a large manufacturer of equipment for the automotive industry. The most widespread opinion among his colleagues in the automotive industry--who have been caught completely by surprise--is: Still another headache! Just what we needed to throw more light on things!

The Carburol Plan is first of all a program of research, technological development and support of industrial and agricultural experimentation, designed to determine the best methods of producing substitute fuels and to lower the cost of agricultural origin.

The Why

The use of nonpetroleum fuels in the transportation sector is a way to economize on petroleum and a factor in the strategic reduction of supply-vulnerability.

The Wherewithal

More than 120 million francs, including 100 million francs of public credits, have been allocated this year to the testing and development of different methods.

The How

--The methods: A definite choice has not been made. The final choices will be the most competitive methods. Two of them are now in the running: the manufacture of methanol from combustible raw materials (wood, coal,...); and the production of acetone-butyl mixtures from vegetable substances (straw, Jerusalem artichoke,...). Standby solution: the ethanol method (by fermentation of sugars and starches), which is currently not viable (2 to 3 times the cost of premium gasoline). The synthetic gasoline method (from coal or gas) is not deemed worth pursuing (costly in energy).

--The approaches: Called for during 1981 and 1982 are: Studies and tests on agricultural raw materials; studies and tests on motors; demonstration (pilot) models of: gasification of wood using an oxygen process; synthesis of methanol and higher alcohols; and acetone-butyl production (enzymatic hydrolysis, acidic hydrolysis). In addition, the coal gasification program will be speeded up.

The When

Effective immediately, additives in the form of alcohols and approved ethers are authorized, within a limit that is fixed, following tests, for each type of carburol, but which must not exceed 10 percent. The mixtures, to be dispensed by normal gasoline pumps, have no adverse effect on motors.

Approval of new ingredients and of their manufacture will not be granted by the Substitute Fuels Mission (Ministry of Industry, Directorate of Hydrocarbons) unless prior tests show the proposed mixture to have the same specific consumption as premium gasoline. A Substitute Fuels Production Commission (CPCS) is charged with establishing market penetration objectives in accordance with the evolution of the different methods.

Beginning in 1985, when the production of carburol fuels will be significant (1.5 million tons of consumption), a new fuel incorporating up to 50 percent of alcohols and ethers may be authorized to be marketed by an appropriate specific network and for a given number of automobiles designed to use it (motor adjustments, materials).

Andre Giraud, Pierre Ayzat (director of petroleum research) and the R 18 prototype designed to run on 25 percent alcohol. In projecting a 50-percent mixture by 1985, the "carburol" program has set the bar a little higher.

No Tried, Tested Method

Paris INDUSTRIES & TECHNIQUES in French 10 Feb 81

[Article by C. G.]

[Text] "Carburols" are oxygenated organic compounds extracted from petroleum, coal or vegetable substances. Mixed with hydrocarbons, they burn in controlled-ignition motors.

The government has decided on three lines of study: the ethanol method based on the fermentation of compounds rich in starch or in sugars (glucose and sucrose), the methanol method based on synthetic gas, and the acetone-butanol method which makes use of the fermentation of vegetable compounds.

The ethanol method (ethylic fermentation) is well known in France. But its energy balance sheet is unfavorable (low yield and high calorific requirement for its distillation). Furthermore, the use of ethanol as a fuel is very difficult: its miscibility with hydrocarbons is low, while with water it is high (storage problems), and its toxicity is not negligible.

On the other hand, since it could be produced from domestic sources, it would reduce our dependence on foreign sources. However, its production cost would have to be reduced substantially, which appears very unlikely...

The methanol method is currently the best known one. French production approaches 400,000 tons. Its cost of production: around 1.30 francs per liter. But its calorific value is less than half that of gasoline. Assuming that by 1985 the government's objective of 15 percent methanol in fuel (around 20 million tons) is attained, this will require that French production be multiplied by a factor of 8 over a period of 4 years. A 2,000 ton-per-day plant using natural gas as the base substance takes around 3 years to build... What is more, the problem of raw materials becomes crucial. France does not have natural gas or coal in sufficient quantities. Suppliers more reliable than the Middle Eastern countries would have to be found: around the North Sea, for example.

Methanol is made from synthetic gas (essentially, hydrogen and carbon monoxide) obtained through the reforming of natural gas or the gasification of coal or of vegetable substances. Natural gas and coal do not pose technical problems. On the other hand, the use of vegetable substances, particularly wood, has in no way been resolved. Wood, before it can be converted into synthetic gas, must be produced and collected (rational use of forest land), preprocessed (felling, cutting up, drying...), and converted into a gasogene. The first two stages require a substantial organizational effort. Its gasification has been under study by the CNEEMA [National Center for Studies and Experimentation on Mechanization of Agriculture] since 1975. A pilot plant with a capacity of 1 ton of wood per hour that is, around 500 kg/hr of methanol, is operating with air as the oxidizing agent. A second 10-ton/hr plant using oxygen is being planned for the beginning of 1982. Pure oxygen eliminates nitrogen from the air, which otherwise requires calories to burn. On the other hand, since the combustion is more intense, its regulation is more difficult and its temperature higher (around 1200° C). Ash is molten at these temperatures and clogs up the installations. Gasification using oxygen will therefore be difficult to perfect. All of this notwithstanding, it is estimated currently that, using French wood delivered to the warehouse at 200 francs per ton dried, methane will cost about 1,200 francs a ton, which is around 2,400 francs per oil-equivalent ton.

To overcome some serious methanol-gasoline-water miscibility problems, the IFP [French Petroleum Institute] is working on a synthesis that would furnish directly a 15-percent heavier-alcohols methanol mixture. But the toxicity of methanol is also not negligible...

The products of the acetone-butanol method appear to involve the least problems from the standpoint of their use in mixture with hydrocarbons. This method, however, is essentially biochemical and therefore entails problems of preprocessing the raw material (straw, cornstalks, giant reed, Jerusalem artichoke, potatoes...). These vegetable substances, after acidic or enzymatic hydrolization, yield sugars which, through fermentation, lead to a mixture of 65 percent methanol, 35 percent acetone, 10 percent ethanol. Even the pentose sugars are converted in this operation. The process is not unknown, since the Societe Melle used it until 1954 in various plants. After fermentation, however, the liquid obtained contains a great deal of water that must be eliminated through several distillations. A revolutionary drying process must still be discovered to ensure the anti-gasp quality of the mixture... To incorporate a 10-percent acetone-butyl mixture, obtainable only from Jerusalem artichoke, 800,000 hectares of the latter would have to be cultivated. The economic evaluation of the three methods is very critical. Meanwhile, the time required for such evaluation is delaying the building of large-scale installations. Sweden, which has already got its alcohol-fuels plan under way, is aiming at only 15 percent methanol in its gasline by 1988, with an investment of 11 billion francs. New Zealand has also made its policy choice: to eliminate all problems of modifying motors and production and distribution cycles, it has decided to build a plant to synthesize automotive gasoline using the Mobil process. 600,000 tons of this gasoline are to be produced in 1985; to cover one third of the national consumption at a cost estimated to be double what it would be if the raw material were oil.

Problems For Engines

Paris INDUSTRIES & TECHNIQUES in French 10 Feb 81 pp 11,12

[Article by J. L. T.]

[Text] Although the Carburol Plan has created a stir among the public, the automobile makers have remained surprisingly silent. From the R 18 to the 505 to the Visa, each one has unveiled a test vehicle that "runs without problems after appropriate adjustments." It is as if the addition of alcohol to premium gasoline would have little or no adverse effect on motors that normally use hydrocarbons. Why then the millions of kilometers being run by Volkswagen experimental models and by Volvos, the many tests by Fiat, Ford, General Motors and others?

In fact, the number of parameters that must be taken into account is so large that the builders themselves are unable to agree on the dosage of mixture beyond which troubles begin. Renault says over 5 percent alcohol, Volvo says over 15 percent. Volkswagen, which has had the benefit of the Brazilian experience, is running vehicles using a 20-percent methanol mixture, at the price, of course, of many modifications.

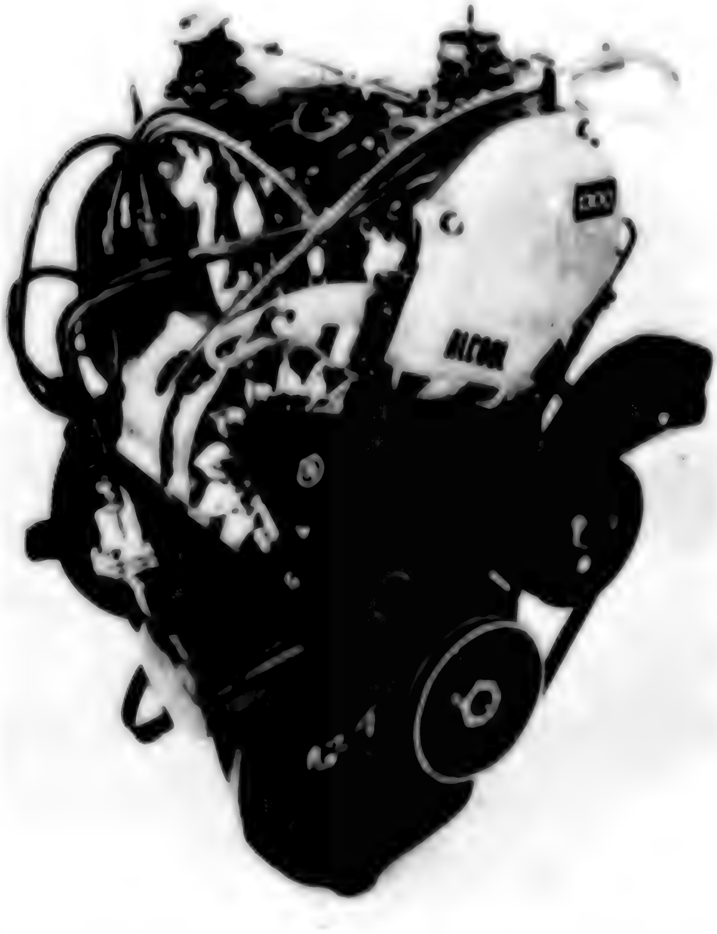
Simply stated, it can be said that the problems to be resolved are minimum up to 15 percent of alcohol in the mixture. Although the introduction of 10 percent of methanol impoverishes the mixture and increases consumption, a rich mixture, on the other hand, improves efficiency, and the increased consumption is thus offset. Volkswagen found that with mixture M 15 (15 percent methanol, 85 percent gasoline) maximum power of the engine was reduced by 5 percent, but its energy efficiency was increased by 7 percent. However, one arrives at the following paradox: The adding of alcohol is less effective for vehicles of recent design that are built to run on poorer mixtures.

Things get complicated when the fateful figure of 15 percent is exceeded, and it no longer suffices to raise the compression ratio to compensate for the calorific losses (gasoline: 10,600 kcal/kg; methanol: 4,700 kcal/kg). A number of problems make their presence felt, beginning with those of cold starting. Steering problems have been noted at -10°C and below with M 15 fuel. At high temperatures, the alcohol produces vapor locks that generate hesitation on acceleration and even fuel supply failures.

Another problem: The compatibility between alcohol and engine materials. The chemical reactivity of methanol is higher that that of gasoline and causes corrosion or premature wear of certain components. Thus, it is found that with a 15-percent alcohol fuel the lead lining of the fuel tank comes loose, Rislan tubing gives way, blisters form in resinous paper filters, and polyamide-resin floats swell up. An analysis of the gums in a fuel that has been stored in reinforced polyester laminate reservoirs also shows that the presence of 10 percent of methanol multiplies the formation of compounds by a factor of 6. This is to say nothing of the short life of rubber valves in the engine's fuel pump, of the possible corrosion in magnesium carburetors, and, with 50 percent methanol, in aluminum cylinder heads.

Still another important obstacle is the problem of phase-separation within the mixtures, particularly in the presence of water. The problem is exacerbated all the more by the difficulty of obtaining large quantities of strictly anhydrous methanol; to say nothing of the fact that the humidity of the air during storage is of no help. To avoid this breakdown of the mixture, two possible solutions would be to add a third solvent (heavy alcohols produced, for example, by the Acetone-butyl method) or to raise the aromatic hydrocarbons content of the gasoline. Another possibility would be to use a dual fuel supply system. In this case, at low engine speeds and low loading, the engine would be supplied only with gasoline.

The final stage in the use of alcohol has been reached by Fiat, which, with its Model 147, is the first automobile maker to have mass-produced a vehicle that runs on pure alcohol alone. The 147 is actually a 127 whose engine has been adapted. The entire carburetor has been modified (jets, inlet aperture,...) and built of materials that are resistant to corrosion, as have also the fuel tank, tubings and the fuel pump diaphragm. To eliminate the starting problems at temperatures below 10°C, Fiat has devised a system of solenoid valves that permits a small dose of gasoline, coming from an auxiliary tank, to reach the carburetor. The Belo Horizonte (Brazil) plant is to produce 200,000 of these cars a year beginning in 1981-1982.



Mass-produced since 1978 at Belo Horizonte, this 1,300-cm^3 engine runs on pure alcohol. Its development took 3 years. It now powers the Fiat 147.

9399
CSO: 3102

ENERGY

BRIEFS

BRAZILIAN ALCOHOL FOR CARBUROL--The ELF-Aquitaine (France) and PETROBRAS [Brazilian Petroleum Corporation] oil companies are planning to build in Brasil a distillery capable of producing 1,200,000 liters of alcohol a day. This will be used to produce carburol in France, official sources in Brasilia reported on 5 February. A delegation from the French firm is expected in Brazil next month, where it is to study this project which is being conducted in association with other Brazilian firms, stated an official from the ministry of mines and energy. Investments in the project are estimated at $150 million, with the share being financed by PETROBRAS amounting to $50 million. It will take 4 years to complete the distillery. Mr Cesar Cals, the Brazilian minister of mines and energy, explained that the Brazilians were "practically forced" to accept the involvement of PETROBRAS in this project. ELF-Aquitaine, he explained, is already working with PETROBRAS in Guatemala and in China and it insisted that PETROBRAS take part in this project. Mr Cals believes that the Brazilian firm should concentrate on petroleum prospecting and production. [Text] [Paris AFP SCIENCES in French 12 Feb 81 p 34] 7679

STORAGE OF SOLAR ENERGY--The Hague. The basements of a group of new houses in the Netherlands will be used to store solar energy intended for residential heating, the TNO [Dutch Applied Research Institute] announced on 11 February. The project involves a group of about 100 houses to be built in Beijum near Groningen in the far north of the country. Solar panels will be placed on the roofs of the houses, and the surplus heat that is not used will be stored in collectors installed in the basements of the houses. An antifreeze compound will be added to the water heated by the solar panels. This procedure was developed by the TNO in collaboration with the Philips company and with the financial backing of the government of the Netherlands and of the EEC [European Economic Community]. [Text] [Paris AFP SCIENCES in French 12 Feb 81 p 35] 7679

1981 BUDGET FOR COAL TECHNOLOGY--The Federal Government's new budget for 1981 provides a total of DM 357.4 million for coal research and upgrading. The funds are distributed as follows by specialized areas (costs in millions of DM): 1. Coal upgrading facilities through the Federal Ministry for Economics--25.0; 2. Development of facilities for upgrading coal through the research ministry--153.8; 3. Production of gas from coal--11.0; 4. Coal liquefaction--10.0; 5. Generation of electricity from coal--32.8; 6. Production of coke--24.0; 7. Mining technology--100.8; The division of labor between the Federal economics and research ministries is planned in such a way that the planned large-scale coal-upgrading facilities are financed under the auspices of the Federal Ministry for Economics. For a start DM25 million have been earmarked for this but they have not yet been released. Through the Federal Ministry for Economics investment subsidies are to be paid to those running the coal upgrading facilities in the 1980's. The details still have to be determined. The research ministry is to continue to finance, from its budget, pilot plants for coal gasification and liquefaction, some of which are already in a state of construction or operation. The purpose of the coal gasification plants is to manufacture synthetic gas for the chemical industry. For this DM 70.5 million are earmarked, while DM 83.3 million have been appropriated for coal liquefaction. For the time being, however, no definite decisions on large-scale technical facilities and, above all, their financing, may be expected. A series of study projects are still in progress. [Text] [Frankfurt/Main FRANKFURTER ZEITUNG/BLICK DURCH DIE WIRTSCHAFT in German 11 Feb 81] 5058

CSO: 3102

INDUSTRIAL TECHNOLOGY

FRENCH REPORT ON INDUSTRIAL ROBOTICS IN FRG

Paris LE PROGRES TECHNIQUE in French No 10, 80 pp 22-25

[Excerpt]

[Reprint of a commentary by Christian Deleplace prepared by the Scientific Department of the French embassy in Bonn]

[Excerpt] Introduction

After an overview of industrial robotics in the FRG, the use of robots will be examined from various points of view:

technical considerations--level of development of the products currently on the market, and improvements planned;

economic consequences--profitability, increase in productivity; and

social implications--qualitative and quantitative effects on employment.

These three factors are closely related, in fact, and it is necessary to take them into simultaneous account in any attempt to predict the development of industrial robotics in the FRG. In our conclusion, we will attempt to set forth the prospects for the future.

Robots in West German Industry

We will use the term "robot" to mean any handling device which can be programmed, even if its capacity to comprehend its environment is very limited (in the strict sense of the word, a true robot should in fact, by means of the proper pickup mechanisms, be able to analyze its environment precisely). With this definition, which it is important to provide, since figures vary greatly depending on the broader or narrower meaning attributed to the word "robot," we can note the development shown in figure 1.[1]

Figure 1: Development of the Number of Robots Used in Industry

1974	130
February 1979	520
August 1979	650
October 1980	1,230

As can be seen, the rate of growth has clearly speeded up.

Main Users and Producers

One out of two robots functions in the automobile industry:

either in direct use by manufacturers:

VW, with its own products;

DB, to an increasing extent, despite the initial difficulties with the first generation welding robots;

Opel-GM, which is proceeding more cautiously after the unhappy experience with the first Russelsheim robots; and

BMW, with a more recent but ambitious program (see below);

or in use by their suppliers, for example in metallurgy, where robots replace men where working conditions are particularly harsh (foundries, forges).

The electrical household appliance industry is also making increasing use of robots (production of turntables, television sets), as are manufacturers of ceramic products.

Volkswagen, with 3 to 400 robots in use in its factories, was both the first user and the first producer of robots in the FRG, in an effort not only to meet its own needs but also to sell its products on the market (its competitive situation with regard to other West German automobile manufacturers, moreover, made obtaining supplies from them more difficult). Next in rank, with about 15 percent of the market, is the IWKA [Industrie Werke Karlsruhe Augsburg] affiliate including Keller and Knappich (better known under the name KUKA) in Augsburg, the French ARO company in Chilly-Mazarin, and Roth Electric in Gaytring. The official in charge is Burkhard Wollschlager, who hopes to make KUKA number one in robotics in the FRG shortly. He is aiming for a turnover figure for the robot department totaling 30 million DM in 1981 (as compared to 10 in 1980), serving to offset the 10 million DM invested in the past 10 years in research and development. In fact, the order BMW has just placed with KUKA is the largest ever in this sector for the FRG--125 robots, the majority for welding, including 87 crane robots which are barely past the prototype stage at KUKA. The total value of the order come to about 33 million DM, with delivery between now and mid-1982. These robots, moreover, are only some of the 300 which BMW plans to install in its plants in the course of the next 18 months.

We might also mention, on a less important level, the Liebherr group, Zahnradfabrik Friedrichshafen, and the VFW-Fokker airplane factory, as well as Bosch and Siemens, which use the robots of tomorrow equipped with high performance sensors.

Robot Distribution

The distribution of the 649 robots in use in the FRG in August 1979 is shown in figure 2 (source: IPA).

Figure 2: Distribution of Robots by Sector

	Use Sector	%
Tool Operation	Treatment of surfaces*	15
	Spot welding	16.5
	Continuous welding	2.5
	Fettling	1.5
	Miscellaneous	1
Handling of Party	Casting under pressure	10
	Molding by injection	10
	Presses	9.5
	Forge	8
	Miscellaneous	20
Assembly		1
Research		2.5
Unknown		2.5

* Spray painting, application of protective coatings, etc.

The numerical superiority of robots handling parts can be noted (57.5 percent as compared to 36.5 percent operating tools, essentially for technical reasons). Moreover, the treatment of surfaces and welding appear to be the classic uses, while fettling and assembly are still in the initial stages, in contrast with Japan, where assembly robots, controlled by microprocessors, account for 20 percent of all the existing installations.

Technical Aspects

We will take up in turn the various components of the robot, discussing the current degree of development for each and the future prospects.

Mechanical Structure

West German manufacturers are all working in the direction today of producing a mechanical structure characterized simultaneously by:

lightness, to facilitate the handling of the robot, either by its training system or by man, when programming is done by means of continuous apprenticeship (spray painting, for example); and

rigidity, in order to prevent vibrations inherent in the structure itself from endangering precision in the event of short and quick movements.

Moreover, one of the extremities of this mechanical structure is the source of one of the bottlenecks hindering the wider utilization of robots: the gripping claw. The human hand has in fact 22 angles of movement. One can readily imagine the difficulty of achieving and the complexity of an equally high performance mechanical system. As developing a claw consistent with its planned use is not entirely satisfactory either (the American Unimatic company produced more than 4,000 such claws for the 3,000 robots it had already marketed by the end of 1978), the trend in the FRG is toward the following two solutions:

a set of claws from which the robot chooses automatically that required for the execution of its next task; and

the developed claw, with adaptive modifications to the parts to be tooled or handled (embossing, reaming, etc), which is becoming standard.

Drive Power

The drive power is dictated by the size of the part to be handled, the speed of movements required and the precision necessary in the repetition of the movement, and can be of three kinds:

electric (currently 13 percent of the market);

hydraulic (42 percent); or

pneumatic (45 percent).

Electric drive power seems to be regarded as the solution of the future at present in the FRG, thanks to the high performance low clearance direct current motors (Gleichstromscheibenlaufermotor). They have been successfully tested on machine tools. They are sturdy, reliable, easily regulated, and yet cheaper than hydraulic powered apparatus. The energy density is good, since they transform electrical energy directly into mechanical energy at less risk (no pollution from oil, no uncontrolled leakage, etc).

Programming

Command devices which can be programmed, for their part, have benefited from the enormous advances made in microelectronics and the spectacular reduction in the cost of electric components. Programming still utilizes two apprenticeship processes:

either continuous, as needed, with the help of a "stand in" to facilitate the operator's tasks; or

point-by-point, with the possibility of programming in certain previously stored sequences.

Sensors

However, it is in the sensor field that the greatest research and development efforts are being made in the FRG currently. In fact, due to the failure to provide the current robot with the means of perceiving their environment correctly, the profitability of the process of robotization has in many cases been endangered, giving rise to tasks in the area adjacent to the robot which require no skill but must be carried out by man. On the other hand, the high performance sensors currently being studied in the FRG will allow the robot to recognize parts, to eliminate those which are defective, to place others for tooling, to determine what task is required, to adapt to changes in the environment (an obstacle to be avoided, for example) and to provide information which can be dealt with in real time. In brief, the sensors will provide the robot with that "artificial intelligence" which is lacking today.

The present sensors are either acoustical (a limited number), contact (feelers), or optical (telesensors, infrared, laser). For the latter, the problem is the processing of the large quantity of data they supply in terms of a limited--and thus easy to handle--number of factors, sufficient however for the task to be accomplished (for example, recognition of the object). Apart from this, it is in these optoelectronic sensors that the FRG places its greatest hopes. Among the studies done in this connection we might mention:

the robot camera recently brought out by Brown, Boyery and Company (BBC) of Mannheim-Heidelberg, on the occasion of METAV '80.[2] The image recorded is divided into 100,000 points, which a computer identifies individually, classifying them black or white. Characteristic points are then determined (for example, intersections with certain concentric circles), and by means of a comparison with a model previously stored in memory, an object, even while in movement, can be recognized and a machine tooling or handling robot can be activated as a result;

the development by the IPA of optical sensors enabling a robot which must select a part to verify that it has actually picked it up, on the one hand, and that the part falls well within the acceptable tolerance limits, on the other, following which the robot can proceed to place the part in a given position; and

the study carried out by Bosch and Siemens and presented at the INTERKAMA '80[3] (recognition of special shapes).

Thanks to these more effective sensors and the miniaturized and inexpensive products provided by microelectronics, the processing of data supplied by robots in real time can be foreseen, whereas it has not until the present been defensible economically. Within the framework of the Deutsche Forschungsgemeinschaft (DFG) "Schwerpunktprogramm"[4] on the handling of such data in real time through the use of microprocessors, we should note the work done by the mechanical department of the Duisburg Gesamthochschule, intended without a doubt to close the gap which has developed between the FRG and Japan in this field.

FOOTNOTES

1. These figures were provided by the Institut fur Produktionstechnik und Automatisierung (IPA), one of the institutes of the Fraunhofer Society, located in Stuttgart and specializing in production and automation techniques, one of the six main fields in which the Fraunhofer Gesellschaft (FhG--Fraunhofer Society for the Advancement of Applied Research) is active. Its director, Professor Warnecke, is one of the FRG's finest experts in robotics. The FhG is the most important research institution in the FRG working on contract, thanks to which it is 57 percent self-financing. A self-administering body which manages 25 institutes, it comes under the jurisdiction of the Ministry for Research and Technology (BMFT) and the Ministry of Defense (BMVg).

2. METAV '80 was an exposition held in Dusseldorf from 27 to 31 March 1980, which was attended by 850 exhibitors specializing in machine tools and precision work.

3. Internationaler Kongress mit Ausstellung fur Mess- und Automatisierungstechnik (International Congress and Exhibition on Measuring and Automation Techniques)--an exhibit and congress held in Dusseldorf from 8 to 15 October 1980 and attended by more than 100,000 visitors. There were 1,100 exhibitors on the theme of measuring and automation techniques.

4. The Deutsche Forschungsgemeinschaft (German Association for Science) has as its members the majority of the universities, the Max Planck Society, and the large scientific institutions, and its purpose is the financing of basic research. Its senate determines priority programs, the "Schwerpunktprogramme," the equivalent of our French Programmed Thematic Actions (ATP).

5157
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SCIENCE POLICY

NEW RESEARCH MINISTER STATES VIEWS ON POLICY, AID

Duesseldorf HANDELSBLATT in German 9 Mar 81 p 3

[Report on interview with Andreas von Buelow: Research Budget Is Not To Be Looted]

> [Text] Duesseldorf, 7/8 Mar 81--In an interview with the editors of the HANDELSBLATT Federal Research Minister Andreas von Buelow stated that the pilot high-temperature reactor at Schmehausen and the pilot rapid breeder at Kalkar would be financed by the Federal Government with an annual "underbudgeting" of DM 150-200 million, and that energy supply enterprises should cover that shortfall. However, no funds for possible successor projects of these pilot enterprises have been earmarked in federal budget planning.

Construction costs of the high-temperature reactor at Schmehausen will rise to some DM 3 billion marks by the completion date. About DM 2 billion have already been invested. A research study is underway, to be completed this May, which is to evaluate the future chances of this line of development. "Only then can a decision be made regarding followup projects."

However, the research minister left no doubt that he feared that a continuation of the HTR line would not be profitable under current conditions. The Schmehausen plant, with a maximum output of 960 degrees, could not achieve the 1,500-degree temperatures necessary for coal gasification. Only basic research could determine whether the idea of coal gasification and nuclear plant unification was feasible. In that regard the high-temperature reactor technology is currently in no way economically feasible. A high-temperature reactor is in no way more efficient than a light-water plant as far as generation of electricity is concerned, and even the question of its contribution to heat generation is controversial.

In any case the research minister does not have any money for financing of followup projects of the high-temperature reactor for the foreseeable future. The decisive question is whether in the next decades a market would open up for the HTR type. To the minister's knowledge only the USSR is working on a similar project.

In any case, however, both demonstration projects--the HTR as well as the rapid breeder--would be carried to conclusion, even though they would be "underbudgeted" by DM 150-200 million annually, a sum that should be covered by energy enterprises. Negotiations regarding this financial contribution of the private sector are currently in progress, and seem to be going quite well.

In this connection von Buelow asks the basic question of whether German coal should not be reserved for domestic heating and electricity production, and whether coal liquefaction should not be transferred from German plants to cheaper foreign coal, such as Australian. Gasoline production from German coal will hardly be economical, since it would have to be heavily subsidized to be marketable.

It would be nonsensical to establish a technical infrastructure for coal liquefaction with its adverse effect on the environment on the basis of imported coal in the FRG. It would be logical to export German coal liquefaction technology to the site of the cheap raw material and then import the liquid coal with traditional transportation means--tankers and pipelines.

The fact that the FRG no longer wants to participate in the synfuel project in Morgantown in the United States does not reflect on such a concept. For the Reagan administration the project has also become too expensive, and it had withdrawn as a partner. A new solution must now be found on hand of diplomatic negotiations.

Von Buelow thinks that the rapid breeder should at least be maintained as one option for the German industry, so that it would not become totally dependent on France. The German energy producers are also greatly interested in the development of the rapid breeder. They should participate in its financing, whether via a fund or a separate institution. In this question von Buelow expects financial contributions of DM 300-400 million. Without such participation the entire German research edifice up to the Max-Planck-Institute has to be looted in order that such projects can be carried out. The research minister, however, denies that he has ever made a serious proposal of a "research tax."

The research minister criticized the different responsibilities in the field of coal refinement. The Research Ministry if responsible for the advancement of coal liquefaction and is currently carrying out three pilot projects with an annual budget of more than DM 100 million. The Ministry of Economics, however, "I don't know why," is responsible for coal gasification.

With the use of the cheaper Australian coal coal liquefaction is economically feasible even today. The same holds true for German brown coal. It is, however, not realistic to think that even 30 percent of the motor vehicle traffic of the FRG could be fueled with gasoline made of German coal, if only for the fact that the necessary plants would founder on the resistance of the citizenry that has been very sensitive in such questions ever since 1972. Here, too, the alternative is available--export of technology and import of the products.

The research minister thinks that the European industry "is in a tailspin" as far as airplane construction, data processing, and microelectronics are concerned. The innovative pressure has come from the United States. However, the American advantage is due to the fact that the American airplane industry has been able to finance its research for many years from the defense budget, and that the American air force has provided a guaranteed market for the products of such research. Miniaturization is also a product of government projects, such as the space exploration. The U.S. defense establishment alone provides a DM 20 billion annual market for microelectronics.

In Japan, on the other hand, the efficiency of the research policy is due to the close cooperation of large industry, major banks, and the government. "Japanese major firms, for example, can push their microelectronics through the entire spectrum of their production, and then direct the results to the world markets. I find it spooky, that in such circumstances we are allowing ourselves the luxury of discussing the relative advantages of direct or indirect research support. I am sure that we will not advance the chips of microelectronics with indirect support. I am happy to accept criticism that even in the field of direct research we have functioned according to a trial and error method. But in order to achieve a breakthrough by the indirect method we would have to work on a scale that we cannot achieve. I am aware that a rational research support is also a bit of directed investment; it cannot be anything else."

He greatly respects the market forces, even in research. But if we are faced by a competitor such as Japan that has been attempting to break into the German machine production field the question arises whether the state can leave such an important branch to its own devices. Especially if within the branch the weakest are the ones who determine the speed of advance of the research policy.

Von Buelow stated that a defense of German leading positions in the technological field would require a disproportionate expansion of the research budget. Many firms could perhaps maintain their position without governmental help, but not others. They would expect help from the state.

9240
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SCIENCE POLICY

FRANCO-GERMAN SCIENCE, TECHNOLOGY COOPERATION REINFORCED AT SUMMIT

Paris AFP SCIENCES in French 12 Feb 81 pp 13-14

[Text] Paris. During the Franco-German summit meeting held on 5 and 6 February, a decision was made to reinforce cultural, scientific, and technical cooperation between the two countries. This was made clear in the joint Franco-German statement on bilateral relations, published at the close of the summit, which deals exclusively with the three aspects, and also by the communique released by the French SER [Department of Research].

Pierre Aigrain, the secretary of state for research and his German counterpart, Mr Andrias von Bulow, federal minister of research and technology, had several indepth meetings during this Franco-German summit.

The main points covered in the joint statement are the following:

a. The establishment of an information and research center on contemporary Germany. This university-level center will have the responsibility to "encourage, coordinate, and develop studies on contemporary Germany." It will give all interested users, including local communities and businesses, information on the German scientific, technical, cultural, economic, and political situation.

b. Occupational training. The two parties recommend the expansion of the first exchanges which have taken place within the framework of the agreement on the exchange of young people and adults, which was signed a year ago at the end of the 35th Franco-German summit conference.

c. Shared knowledge and contacts between the population of the two countries. The president and the chancellor advocate the establishment of close ties of cooperation between persons and institutions, particularly in the areas of information, education, socio-cultural organization, and professional life.

d. Knowledge of languages. The "action program" developed by the joint language group calls for the development within an ongoing educational program of a system of courses which can lead to certification and diplomas recognized by both countries, and the intensification of relations between higher education and research facilities.

Grants and scientific prizes will be awarded to leading scientists to enable them to pursue their work by spending time in the partner countries.

The SER communique states that the two ministers of research agreed on the following decisions:

a. To strengthen cooperation in the programming, utilization, and development of major scientific programs, such as the Millimetric Radioastronomy Institute, pointing out all the benefits that the two countries have drawn from joint programs such as those conducted by the Laue-Langevin Institute of Grenoble.

b. To facilitate mobility of scientists, by encouraging young, high-level French scientists, especially in the fields of engineering, to spend time in the FRG.

c. To encourage connections between the two countries in programs lasting for more than 1 year and pairing of French and German laboratories.

d. To award each year prizes for Franco-German scientific cooperation to high-level scientists.

e. To encourage the joint production by the two countries of audiovisual materials of a scientific nature intended for the general public.

The two ministers expressed their pleasure about the recent creation of the Franco-German Association for Science and Technology, which they believe will promote exchanges of scientists and industrialists between the two countries.

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TRAIN WITH HYDROSTATIC DRIVE UNDER DEVELOPMENT

Stockholm NY TEKNIK in Swedish 19 Feb 81 p 48

[Article by Mikael Holmstrom: "SJ's Hydraulic Train Will Continue to Roll"]

> [Text] SJ's [Swedish Railways] and Volvo Flygmotor's experimental train with hydrostatic power transmission will continue to receive development money from the government. The train, which has not yet been shown to the public, has traveled 2,500 km. The aim of the experiment is to determine whether hydraulic motors are an alternative to today's locomotives.

On the surface the train looks like the usual "paprika train" of SJ's type X9, with three cars.

What makes the train different is that a diesel-driven plant is mounted on the middle car. That and the adjustable hydraulic pumps deliver oil to the hydraulic motors. Four axles are also hydrostatically driven.

There is also a hydraulic brake system in the experimental train, which recently has been tested in winter traffic in Ostersund, Storlien, and Sundsvall.

The flow of oil goes from the hydraulic motors to the hydrodynamic brakes (or decelerators) and to the heat exchanger which cools the oil.

The brakes have been tested in operation. The train has heretofore run on a normal timetable at speeds up to 90 km per hour.

Within SJ it is believed that the tests have not been sufficiently comprehensive to allow conclusions to be drawn as to whether hydrostatic power transmission is suitable in trains.

The advantages of hydrostatic operation are that weight is reduced, each car has its own propulsion, and braking and propulsion can be better regulated by control with microcomputers.

It should also make it possible to select drive motors and make the electrical systems cheaper.

The largest advocate of hydrostatic powered trains is Volvo Flygmotor, makers of the hydraulic motors. The government's decision is a go-ahead for STU [National Board for Technical Development] to continue with the project.

At this stage the project, which costs 6 million kronor, is not serious competition to SJ's and Asea's high speed train.

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